Christensen Appendix 1
A Comparison of BLS and Christensen
Total Factor Productivity Methods[23]

BLS and Christensen compute total factor productivity as the ratio of total output to total input. Total output includes all services provided by the telephone local exchange carriers: local service, long distance service, intrastate access service, interstate access service, and miscellaneous services. Total input includes all inputs used by the local exchange carriers: capital (plant and equipment), labor, and materials, rents, and services (hereafter referred to as materials).

BLS and Christensen compute total output using economic indexing techniques. The economic indexing technique involves computing quantity indexes for each of the services provided by the local exchange carriers. The quantity index for each of the services is computed by dividing revenue by a price index for that service. The economic indexing technique then "aggregates" these quantity indexes to an index of total output. The total output index is obtained by computing a weighted average of the growth rates for each service, where the weights are based on revenue shares.

BLS and Christensen, compute total input using economic indexing techniques. Quantity indexes are computed for capital, labor and materials. The economic indexing technique then aggregates these

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[23] BLS methods are described in: U.S. Department Bulletin of Labor,-Bureau of Labor Statistics, Trends in Multifactor Productivity, 1948-81, Bulletin 2178, September 1983; U.S. Department of Labor, Bureau of Labor Statistics, "Multifactor Productivity Measures, 1991 and 1992," USDL 94-327, July 11, 1994; and U.S. Department of Labor, Bureau of Labor Statistics, Labor Composition and U.S. Productivity Growth, 1948-90, Bulletin 2426, December 1993.

quantity indexes to an index of total input. The total input index is obtained by computing a weighted average of the growth rates for capital, labor, and materials, where weights are based on cost shares.

BLS and Christensen compute the quantity index of <u>capital</u> and capital cost in similar ways. Both BLS and Christensen compute the quantity of capital using the "perpetual inventory method." The perpetual inventory method bases the quantity of capital on the cost of plant and equipment added in previous years, adjusted for changes in the prices paid for plant and equipment over time and declines in efficiency of plant and equipment as it ages. BLS and Christensen compute capital cost using a "rental price equation." The rental price equation bases capital cost on taxes, economic depreciation, capital gains, and the cost of capital.

BLS and Christensen compute the quantity index of <u>labor</u> and labor cost in similar ways. The quantity index of labor is based on direct measures such as employees or hours worked. Labor cost is based on wages, salaries, and benefits paid to employees.

BLS and Christensen compute the quantity index of <u>materials</u> and materials cost in similar ways. Materials costs are based on company expenditures for these items. The materials quantity index is calculated by dividing cost by a price index for those services.

Christensen Appendix 2
Construction of Price Indexes for Local, Long Distance, and Intrastate Access Services

The formula used to compute price indexes for local, long distance, and intrastate access services is an approximation to the chain-linked Paasche price index. The chain-linked Paasche price index has the form:

$$\frac{P_t}{P_{t-1}} = \frac{\sum_j P_{jt} \cdot Q_{jt}}{\sum_j P_{j,t-1} \cdot Q_{jt}} \tag{1}$$

where P_{jt} is the price of service j in time period t and Q_{jt} is the quantity of that service provided. Diewert has shown that the chain-linked Paasche price index provides results that are quite similar to those obtained using superlative price indexes and that the chain-linked Paasche price index is superior to the fixed weight Paasche and Laspeyres price indexes.[24]

The computational procedure relies on the information on rate changes found in the Form M. The Form M reports the estimated change in revenue resulting from the rate changes. The change in revenue is obtained by pricing out a reference volume of service at the old and new rates, or:

$$A_t = \sum_j (P_{jt} - P_{j,t-1}) \cdot Q_j \tag{2}$$

where Q_j is the reference volume for service j. The basic formula used in constructing the local, long distance, and intrastate access price indexes is:

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[24] W.E. Diewert, "Superlative Index Numbers and Consistency in Aggregation," *Econometrica*, Vol. 46, No. 4, July 1978, pp. 884-900.

$$\frac{P_t}{P_{t-1}} = \frac{\sum_i P_{jt} \cdot Q_{jt}}{\sum_i P_{jt} \cdot Q_{jt} - A_t} \tag{3}$$

$$= \frac{R_t}{R_t - A_t}$$

where R_t is total revenue in year t. If $\sum_i (P_{jt} - P_{j,t-1}) \cdot Q_j$ equals

$\sum_i (P_{jt} - P_{j,t-1}) \cdot Q_{jt}$ then equation (3) is equivalent to equation (1).

The reference volumes used to calculate the revenue impact of rate changes are generally forecasted volumes, and will not necessarily equal actual volumes. Let the revenue change calculated from the actual volume level instead of the reference volume level be equal to $(1+\varepsilon) \cdot A$. The percentage difference in the price index derived from equation (3) and the chain-linked Paasche price index is given by the formula:

$$\ln\left(1 - \frac{\varepsilon \cdot A_t}{R_t - A_t}\right)$$

If, for example, total revenue in year t is $1 billion, the calculated change in revenue due to rate changes in that year is $30 million (three percent of total revenue), and if ε equals .05 (that is the change in revenue from rate changes, when calculated at actual volume levels, is $31.5 million), then the percentage difference between the chain-linked Paasche price index and the index derived from (3) is -.15%. If ε equals -.05, then the difference is +.15%.

Calculating the Price Index When Rates are Implemented Mid-Year. The calculated change in revenue due to rate changes is reported on an annual basis. In other words, it reflects the impact on revenue for the

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twelve month period following the rate change. If the rate change occurs at the beginning of the year, the full impact of the rate change will be seen in that year. If the rate change occurs mid-year, however, part of the impact will be observed during the current year, with the remainder of the impact being observed in the following year. This implies that the index formula in equation (3) must be generalized to account for mid-year rate changes. In the generalized version of (3), A is replaced by the impact of current year rate changes on current year revenue plus the impact of previous year rate changes on current year revenue. The generalized formula is:

$$\frac{P_t}{P_{t-1}} = \frac{R_t}{R_t - E_t - F_t} \tag{4}$$

where E is the impact of current year rate changes on current year revenue and F is the impact of previous year rate changes on current year revenue (the carryover of previous year rate changes). The carryover of previous year rate changes is equal to the difference between A and E for the previous year, multiplied by the growth in total revenue between the previous year and the current year (in order to incorporate the impact of volume growth on the magnitude of the rate changes).

$$\frac{P_t}{P_{t-1}} = \frac{R_t}{R_t - E_t - (A_{t-1} - E_{t-1}) \cdot {R_t}/{R_{t-1}}} \tag{5}$$

Adjusting the Price Index for Net Credits. Finally, an adjustment must be made to the price index in order to account for any net credits paid from the LEC to its customers. If we define B_t to be revenue before net credits, then B_t is equal to

$$\sum_i (P_{jt} - P_{jt-1}) \cdot Q_{jt} = P_t \cdot Q_t$$

where Q_t is the aggregate quantity index of telephone services. In order to calculate the quantity index Q_t from booked revenue after credits, one must adjust equation (5):

$$\frac{P_t'}{P_{t-1}'} = \frac{P_t}{P_{t-1}} \cdot \frac{R_t / (R_t - C_t)}{R_{t-1} / (R_{t-1} - C_{t-1})}$$

$$= \frac{R_t}{R_t - E_t - (A_{t-1} - E_{t-1}) \cdot \frac{R_t}{R_{t-1}}} \cdot \frac{R_t / (R_t - C_t)}{R_{t-1} / (R_{t-1} - C_{t-1})}$$

where C_t is net credits in year t. This is the formula actually used to compute local, long distance, and intrastate access price indexes. Below we provide a numerical example of this computation.

Exhibit A-1 provides sample calculations for both a rate increase. Revenue is $9,100 in year t-1 and $10,000 in year t. The year t rate increase occurs on July 1; the annual revenue change is $400. In year t-1 there was a rate change on June 5, with an annual revenue impact of $400. Since the year t rate change occurs halfway through the year, its impact on year t revenue is $200 (0.5 * $400). The remaining $200 of the year t rate change will become a carryover in year t + 1. The rate change in year t-1 was effective for 57.5% of that year, producing a $230 (i.e., 0.575 * $400) revenue impact in year t-1. The leaves a carryover of $186.81 (= ($400 - $230)*($10,000/$9,100)) to be accounted for in year t. (Net credits in both t-1 and t are assumed to be $300.)

Once the change in price level is computed for each year of the study, an index of annual rate levels cam be computed by initializing the index at 1.0 in the chosen base year. The index level for each subsequent

year is based on the percentage change in the price level for that year over the previous year.

Table A2.1
SAMPLE RATE INDEX CALCULATION

(a) Revenue for year t, $R(t)$	$10,000.00
(b) Revenue for year t-1, $R(t-1)$	$9,100.00
(c) $R(t)/R(t-1)$	1.0989
(d) Rate change in year t-1, $A(t-1)$	$400.00
(e) Date of year t-1 rate change	June 5
(f) Effective in year t-1 revenue, $E(t-1)$ $(.575 \cdot d)$	$230.00
(g) Carryover in year t, $((d - e) \cdot c)$	$186.81
(h) Rate change in year t, $A(t)$	$400.00
(I) Date of year t rate change	July 1
(j) Effective in year t revenue, $E(t)$ $(.5 \cdot h)$	$200.00
(k) Year t revenue net of rate changes $(a - g - j)$	$9,613.19
(l) Year t-1 credits, $C(t-1)$	$300.00
(m) Year t credits, $C(t)$	$300.00
(n) Adjustment for net credits $(a/(a-m))/(b/(b-l))$	.9969
(o) Change in price index $((a)/(k) \cdot (n))$	1.0371

Christensen Appendix 3
Response to Appendix F:
The Appropriate Data Set to Use in
Analyzing Telephone Industry Input Prices

Laurits R. Christensen, Philip E. Schoech
and Mark E. Meitzen
Christensen Associates
December 18, 1995

In Appendix F of the FCC's First Report and Order in CC Docket No.

94-1, FCC staff members, C. Anthony Bush and Mark Uretsky consider

whether short-run or long run input price data should be used to forecast

the future trend in input prices.[25] They tentatively concluded that the short-

term input price growth differential measured over the post-divestiture

period, 1984-1992, represented a structural shift in the input price

differential and should be used to forecast future input prices for the

purposes of setting a price cap X factor. However, they do   : * .ly

consider the evidence placed on the record.

In particular, they do not fully evaluate a USTA ex parte placed on the

record on February 1, 1995 in which Dr. Laurits R. Christensen

demonstrates that there is no statistical validity to the claim that there has

been a structural change in the relationship between telephone industry and

U.S. economy input prices (hereafter referred to as the "Christensen input

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[25] C. Anthony Bush and Mark Uretsky, "Input Prices and Total Factor Productivity," In the Matter of Price Cap Performance Review for Local Exchange Carriers, First Report and Order, CC Docket 94-1, FCC 95-132 (March 30, 1995), Appendix F.

price affidavit").[26] Bush and Uretsky stated that the Christensen input price

affidavit was not given full consideration because of differences in the input

price data series used in the affidavit and input price data used by NERA in

this proceeding:[27]

> Christensen's time-series is completely different from NERA's,
> although both are based on data from various studies by Christensen.
> Christensen has provided no justification for using a different version
> of the LEC input price series for the period 1960-1984 than NERA's
> version. Further, Christensen provides no justification for using a
> different beginning date for the series than NERA (1949 instead of
> 1960). Because of these discrepancies, we cannot accept
> Christensen's conclusion that the input price differential is zero.

"Christensen" versus "NERA" data. As explained in the Christensen

input price affidavit, the data used in the affidavit come primarily from the

study of the Bell System total factor productivity and the USTA LEC study,

both performed by Dr. Christensen. The Bell System study covers the 1949-

1979 period, and the USTA LEC study covers the 1984-1992 period. The

1980-1984 period uses data from a Bell Communications Research

(Bellcore) report (1980-1982) and the study relied upon by NERA (1983-

1984).[28] The methods used in the Bell System and Bellcore studies are the

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[26] "An Input Price Adjustment Would Be an Inappropriate Addition to the LEC Price Cap
Formula," Affidavit of Dr. Laurits R. Christensen filed on behalf of the United States Telephone
Association, CC Docket 94-1, February 1, 1995.
[27] Bush and Uretsky, p. 13.
[28] In particular, telephone industry input prices come from the Bell System study for the 1948-
1979 period and the USTA LEC study for the 1984-1992 period. Telephone industry data for the
1980-1982 period come from Bell Communications Special Report SR-FAD-000552 (May 1987);
and, for the 1983-1984 period, L.R. Christensen "Total Factor Productivity Growth in the U.S.
Telecommunications Industry and the U.S. Economy, 1951-1987," Schedule 3 to Direct
Testimony, Case No. PU-2320-90-149, North Dakota Public Service Commission, 1990.

same as those employed in the Christensen LEC study for USTA. As described below, the study relied upon by NERA employs some simplifications relative to the other three studies, making its input price results not directly comparable to the other three studies. However, it is the only data set available for the 1983-1984 period. Minimizing its use to only two years and relying on the Bell System, Bellcore, and USTA studies for the vast majority of the observations provides the most theoretically consistent telephone input price time series available.[29]

It is important to understand that the Christensen data used by NERA for the pre-1984 period come from a study conducted by Dr. Christensen in connection with his 1990 testimony for U.S. West in North Dakota.[30] The study filed in North Dakota was designed to approximate Dr. Christensen's more in-depth TFP studies. Unlike his other more detailed studies of the telephone industry, this study relied on aggregate telecommunications industry data from Bureau of Economic Analysis (BEA) publications (hereafter, this study is referred to as the "telecommunications industry" study).

One of the major differences between the telecommunications industry study filed in North Dakota and the more comprehensive studies, such as the LEC study for USTA and the Bell System study, is the

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[29] In a March 21, 1995 ex parte, USTA explained the sources of the U.S. input price numbers and why they may differ between the "Christensen" and "NERA" data sets.
[30] Direct Testimony of Laurits R. Christensen, North Dakota Public Service Commission Case No. PU-2320-90-149, October 1, 1990, Schedule 3.
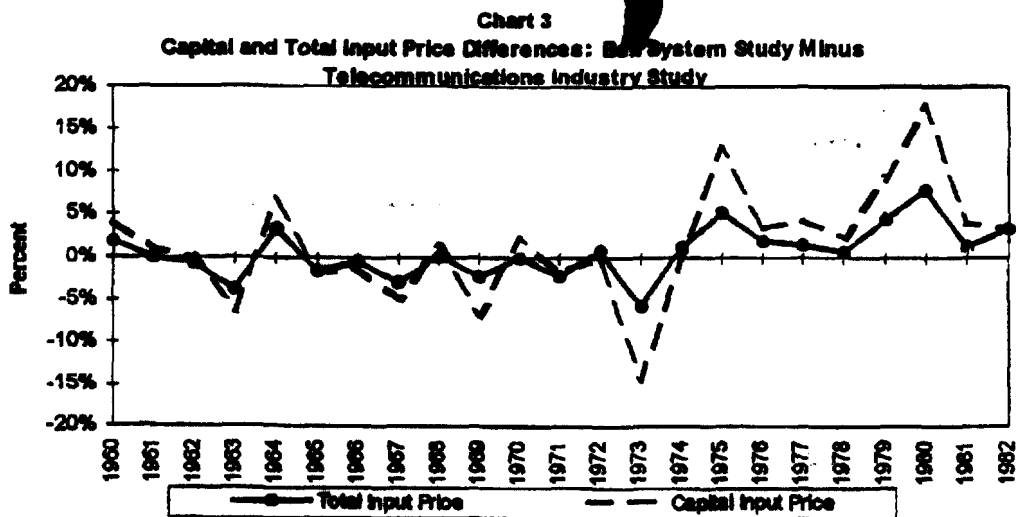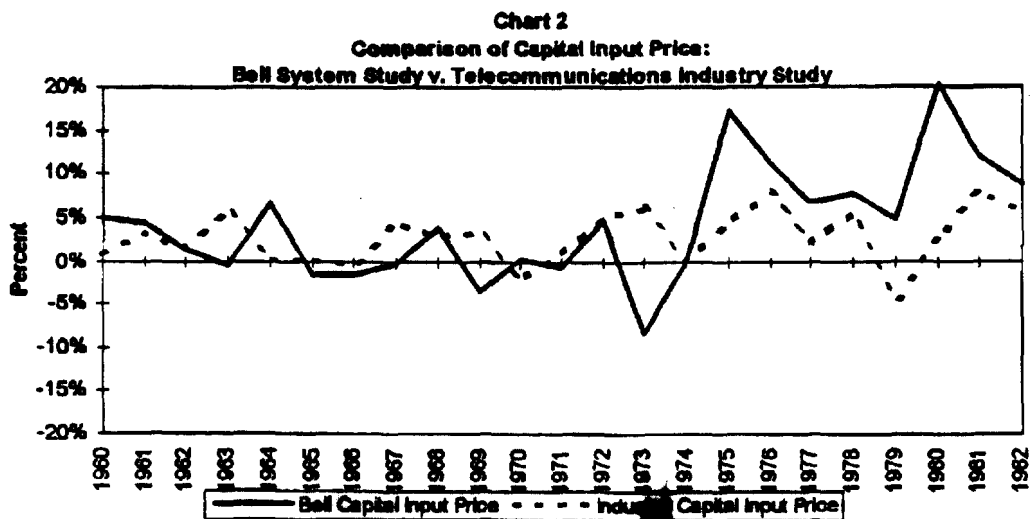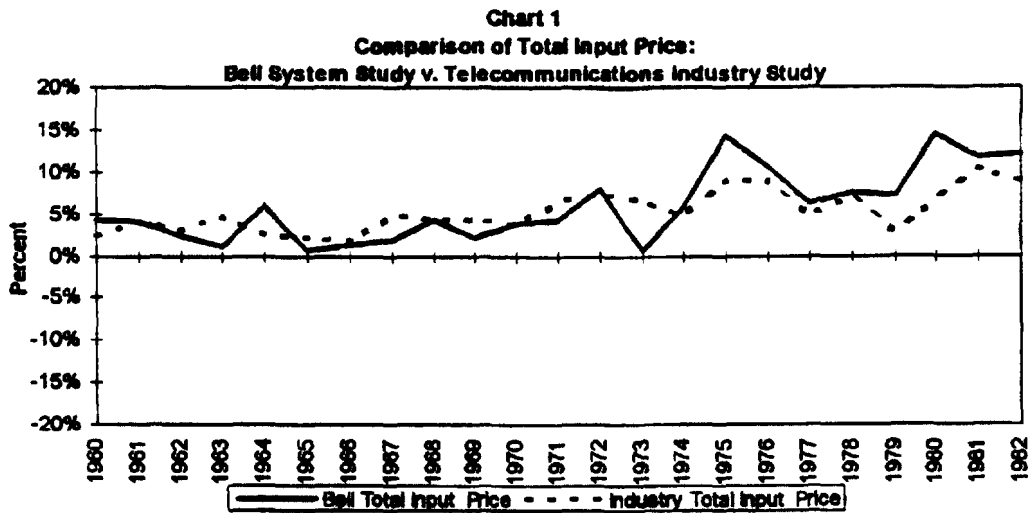
measurement of capital. The telecommunications industry study does not

measure the value of capital with the Christensen-Jorgensen methodology

as the other studies do, but measures it as the residual of gross national

product originating in the telecommunications industry less labor

compensation in the telecommunications industry. In effect, this measures

the value of capital as revenue less labor and materials cost. Therefore,

when the telecommunications industry study filed in North Dakota is used

for the pre-1984 period and the USTA LEC study is used for the post-1984

period, there is a notable lack of correspondence between the methods used

to measure capital input prices for the pre-1984 and post-1984 periods.[31]

This mismatch creates an artificial difference in observed pre- and post-

1984 input prices.

   This mismatch has a minimal impact on TFP results. However, the

telecommunications industry study data set does not exhibit the same

pattern of input price growth, particularly with respect to capital, as the Bell

System input price data set. Specifically, the telecommunications industry

study data set does not fully reflect the large increases in capital input

prices in the late 1970's and early 1980's when interest rates were rising.

This is illustrated in Charts 1 through 3, which compare the input price data

from the Bell System and Bellcore studies to the telecommunications

---

[31] The "NERA data" cited by Bush and Uretsky in Appendix F used the simplified study for
the pre-1984 period and the Christensen LEC study commissioned by the USTA for the
post-1984 period.

industry study for the 1959 to 1982 period.[32] Chart 1 shows the growth in

total input price for the two data sets between 1959 and 1982. Total

telephone input price grew at an annual average rate of 5.8 percent in the

Bell System/Bellcore data and 5.2 percent in the telecommunications

industry study data. Chart 1 illustrates that the price of total input was

much more volatile in the Bell System and Bellcore data. The standard

deviation of total input price growth over the 1959-1982 period was .0423

in the Bell System/Bellcore data versus .0241 in the telecommunications

industry study data. Chart 2 shows that this was primarily due to the

changes in capital input prices in the Bell System/Bellcore data relative to

the telecommunications industry study data. Capital input price grew at an

annual average of 4.3 percent in the Bell System/Bellcore data and 2.8

percent in the telecommunications industry study data. The Bell

System/Bellcore capital input price data was also much more volatile, with a

standard deviation of .0654 versus .0305 for the telecommunications

industry study data. Chart 3 illustrates that the difference in overall input

price growth between the Bell System/Bellcore data and telecommunications

industry study data are clearly driven by the differences in capital input price

growth.

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[32] The first observed growth rate for the 1959 to 1982 period occurs in 1960--i.e., the
growth in 1960 over 1959. Therefore, the first data point in Charts 4 and 5 is 1960.

Chart 1
Comparison of Total Input Price:
Bell System Study v. Telecommunications Industry Study

Bell Total Input Price - - - - Industry Total Input Price

Chart 2
Comparison of Capital Input Price:
Bell System Study v. Telecommunications Industry Study

Bell Capital Input Price - - - - Industry Capital Input Price

Chart 3
Capital and Total Input Price Differences: Bell System Study Minus
Telecommunications Industry Study

Total Input Price   — — Capital Input Price

In summary, the long-term input price data series found in the Christensen input price affidavit, comprised primarily of results from Christensen's Bell System study and Christensen's USTA LEC study, represents the most methodologically consistent series over time. This data series is clearly superior to the one that uses the telecommunications industry study for the pre-1984 period. Moreover, any statistical analysis using the series with the telecommunications industry study data will produce results that show differences in the pre- and post-1984 input price relationships *simply due to the different methodologies used to generate the pre- and post-1984 input price series.* The Bell System/USTA LEC data series represents the most consistent series and, therefore, it is the most appropriate for testing the input price differential. It also means that the Christensen input price affidavit cannot be dismissed on the grounds that it uses different and, supposedly, inferior data: full weight needs to be given to the Christensen input price affidavit in considering whether the X factor should include an input price differential.

Christensen Input Price Affidavit. Given that the 1949-1992 data used in the Christensen input price affidavit represents the most consistent series over time, it is important to restate the major findings of the affidavit. The February 1, 1995 affidavit concluded that, over the 1948 to 1992 period, input prices for the U.S. economy and the telephone industry grew at the essentially same rate. Over this period, input prices grew at an average annual rate of 4.75 percent for the U.S. economy and 4.70 percent for telephone

companies. Statistical tests found there was no evidence that the input price trends differ for the telephone industry and the U.S. economy for the full 1948-1992 period. It is extremely important to note that the same conclusion holds for the 1948-1984 and 1984-1992 subperiods.

This means that any observed short-term differences in input price growth do not represent a difference in the underlying trends of input prices. The volatility of this series is so great that observed differences cannot be statistically distinguished from a difference of zero. This also means there is no statistical basis for using an observed short-run differential as a projection of expected future trends. This is illustrated in Charts 4 through 6.[33]

Chart 4 illustrates that the long-term average growth rates of telephone industry and U.S. economy input prices is essentially identical, resulting in a long-term differential of only 0.05%. Chart 5 shows the long-term differential and the annual values of the differential. It can be seen that there is substantial variability of the annual values around this long-term trend. Chart 6 illustrates that there was a great deal of annual volatility in the 1984-1992 input price growth differential. Annual values of the differential range from -7.8% to +7.7% during this period.

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[33] The first observed growth rate for the 1948 to 1992 period occurs in 1949--i.e., the growth in 1949 over 1948. Therefore, the first data point in Charts 4 and 5 is 1949. Similarly, in Chart 6, the first observed growth rate for the 1984 to 1992 period occurs in 1985.

Chart 4
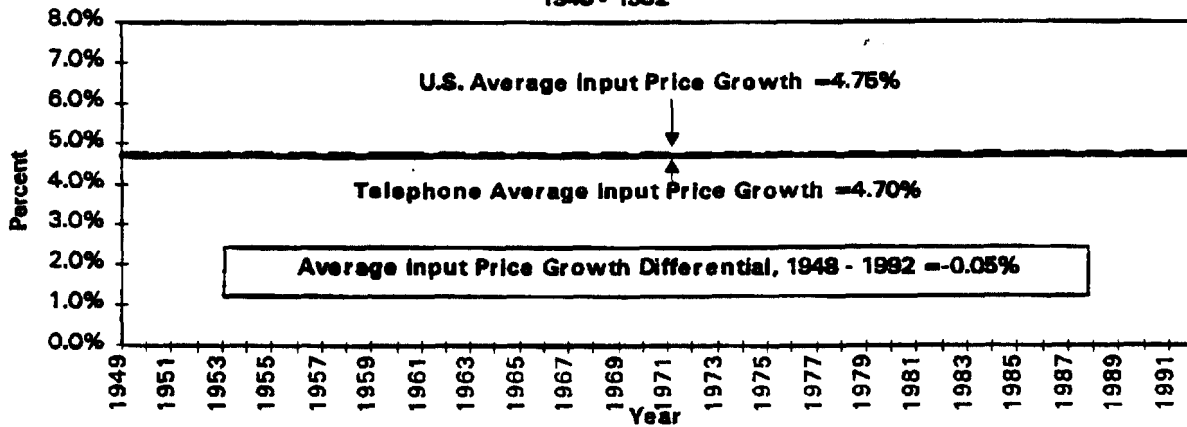**Average Telephone Industry and U.S. Economy Input Price Growth,**
1948 - 1992

U.S. Average Input Price Growth =4.75%

Telephone Average Input Price Growth =4.70%

Average Input Price Growth Differential, 1948 - 1992 =-0.05%

Chart 5
Input Price Growth Differential, 1948 - 1992

1948 - 1992 Average =-0.05%

Annual
Differential
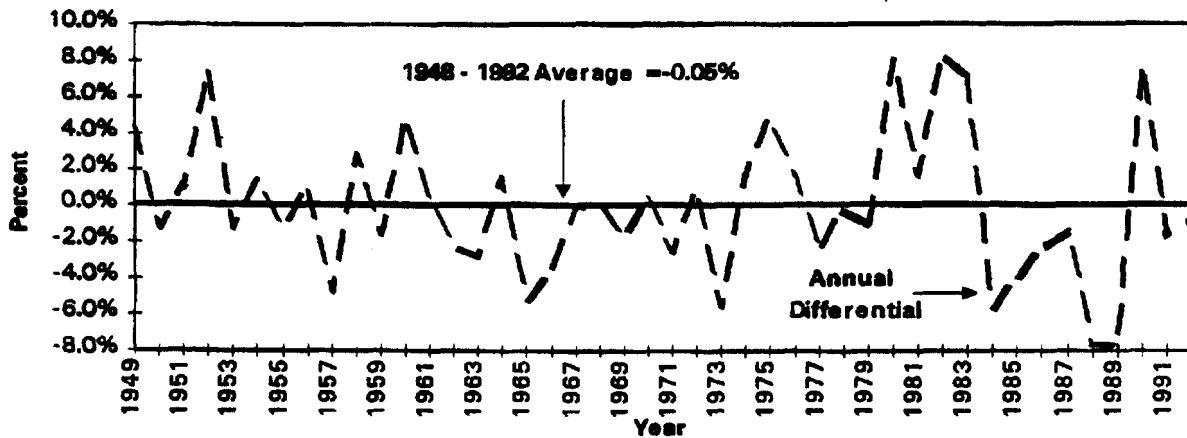
Chart 6
Input Price Growth Differential, 1984 - 1992
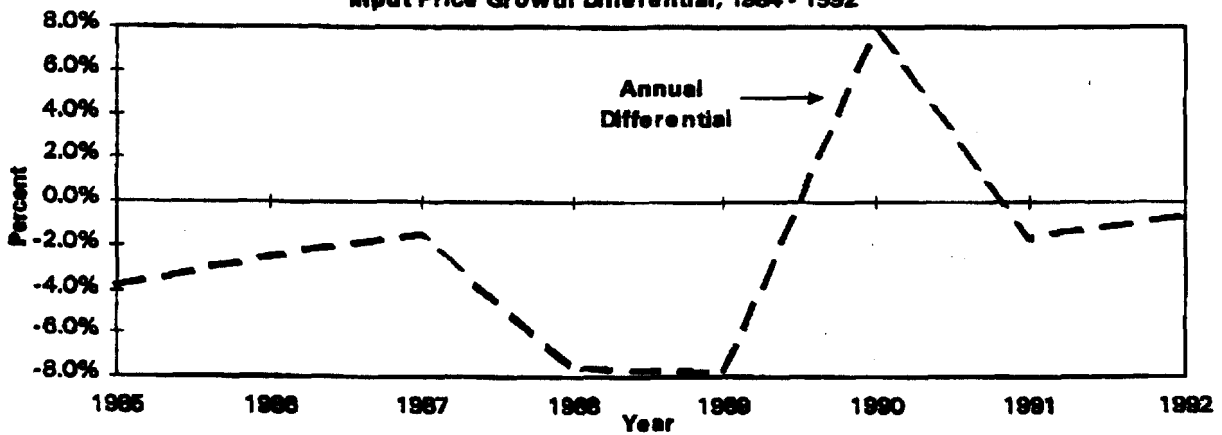
Annual
Differential

The volatility of this series is so great that observed differences cannot be statistically distinguished from a difference of zero, meaning there is no statistical basis for using an observed short-run input price growth differential as a projection of expected future trends.

It is evident from Chart 5 that using the 1984-1992 differential as a basis for projection selectively chooses the only subperiod in the series where the differential was less than zero for a number of years. Events since 1989 indicate the differential has resumed its long-term pattern of random, volatile deviations around zero. The events producing the observed 1984-1989 input price differential are not likely to repeat themselves going forward. From 1984 to 1992 the LEC measured capital input price rose slower than the measured capital input price for the U.S. economy, and the LEC labor input price rose faster than the labor input price for the U.S. economy. But neither of these differences can be properly construed as a change in long-term trends. As I discuss below, because they cannot be expected to continue, they cannot form the basis for a forward-looking regulatory policy.

In particular, the short-term difference in measured capital input prices reflects the fact that measured LEC capital input prices put a much larger weight on interest rates than measured U.S. capital input prices, and the fact that up until 1993 the post-divestiture period has been a time of declining interest rates. The USTA study of LEC productivity growth used Moody's composite yield for public utility bonds as a proxy for the opportunity cost of

capital for all LECs.[34] This yield fell from 14.03% in 1984 to 7.56% in 1993.

It had risen to an average of 8.3% in 1994. Subsequently interest rates have

declined somewhat from 8.3%, but it is very unlikely that the U.S. economy

will soon experience another period of prolonged interest rate declines of the

magnitude experienced between 1984 and 1993.

Because short-term differences in one direction tend to be offset by

subsequent short-term differences in the other direction, the inclusion of an

input price growth differential term in the price cap offset based on recent

short-term fluctuations in input prices is likely to be in the wrong direction.

Therefore, the best estimate of the expected input price growth differential is

given by the long-term differential of zero, not a projection of the 1984-1992

differential.

Tests for the 1959-1992 period. In addition to using a different data set,

the other concern raised by Bush and Uretsky regarding the Christensen input

price affidavit was that the data began in 1948 versus 1959 for the "NERA"

data. Therefore, statistical tests were performed on the "Christensen" data set

over the 1959-1992 period to demonstrate that the inclusion of the 1948-1959

period did not bias the test results presented in the Christensen input price

affidavit.

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[34]Since the yield on public utility bonds reflects the cost of debt, but not equity, and since
the cost of equity is typically higher than the cost of debt, this proxy will tend to understate
the full opportunity cost of capital to the LECs. Moreover, since the cost of debt has
recently fallen relative to the cost of equity, this proxy has declined relative to the full
opportunity cost of capital to the LECs.

Over the 1959-1992 period, telephone input prices grew at an annual average of 4.9 percent versus 5.2 percent for the entire U.S. economy. Shown in Table A3.1 below are the statistical tests of the hypothesis that the trend in input price growth for the telephone industry equals the trend in input price growth for the entire U.S. economy for the 1959-1992, 1959-1984, and 1984-1992 periods.[35]

Table A3.1
Statistical Test of Hypothesis That Input Price Differential is Zero
1959-1992

Time Period	T-Statistic	Critical Value
1959-1992	0.40	2.04
1960-1984	0.41	2.06
1984-1992	1.30	2.36

As with the results presented in the Christensen input price affidavit for the 1948-1992 period, there is no statistical evidence that telephone industry and U.S. economy input price growth trends differ over the 1959-1992 period. Therefore, inclusion of the 1948-1959 period in the "Christensen" data set did not bias the results.

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[35] For each time period, the first observed growth rate occurs in the second year of the period—i.e., the first growth rate for the 1959-1992 period is 1960.

Conclusion

Pre-1984 telephone industry input price data based on the telecommunications industry study filed in Dr. Christensen's North Dakota testimony uses a different method for measuring capital input prices than his more detailed telephone industry TFP studies. Therefore, when using the combination of the telecommunications industry study for the pre-1984 period and the USTA LEC study for the post-1984 period (as in the "NERA" data), any observed differences in the input price differential could just as well be attributed to the different methodologies as to a "real" difference due to a "structural" change in the telephone industry/U.S. economy input price relationship. This renders the Bush-Uretsky results based on the "NERA" data meaningless.

The input price data set used in the Christensen input price affidavit is the most methodologically consistent and, thus, the most appropriate for measuring the relationship between telephone industry and U.S. economy input price trends. The affidavit demonstrated that there was no statistical evidence that input price trends differ for the telephone industry and the U.S. economy for the full 1948-1992 period, or for the 1948-1984 and 1984-1992 periods. Moreover, it has been demonstrated here that there is no statistical evidence that input price trends differ for the 1959-1992 or 1959-1984 periods.

This means that any observed short-term differences in input price growth do not represent a difference in the underlying trends of input prices. In particular, there is no statistical basis for using the 1984-1992 differential as a basis for projecting a differential for 1996 and beyond. Not only does this

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represent the selective choice of the only subperiod in the series where the differential was less than zero for a number of years, but the volatility of the series is so great that observed differences cannot be statistically distinguished from a difference of zero.

ATTACHMENT 2

ECONOMIC EVALUATION OF SELECTED ISSUES

FROM THE FOURTH FURTHER NOTICE OF

PROPOSED RULEMAKING IN THE

LEC PRICE CAP PERFORMANCE REVIEW

National Economic Research Associates, Inc.

One Main Street

Cambridge, Massachusetts 02142

December 18, 1995

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ECONOMIC EVALUATION OF SELECTED ISSUES
FROM THE FOURTH FURTHER NOTICE
OF PROPOSED RULEMAKING IN THE LEC PRICE CAP
PERFORMANCE REVIEW

I.   BACKGROUND AND SUMMARY

The *Fourth Further Notice of Proposed Rulemaking (FFN)* solicited comment regarding methods to establish a long-term price cap plan for the local exchange company (LEC) industry. This paper addresses four issues: (i) trends in LEC input prices and the direct measurement of LEC's unit costs (¶57 and ¶61); (ii) the measurement of separate productivity growths for interstate, intrastate, regulated and nonregulated services, (¶64, ¶65 and ¶70); (iii) AT&T's Historical Revenue (¶80-83 and ¶88-89) and (iv) the consumer productivity dividend (¶ 94-95).

In general, we find that post-divestiture point estimates of the difference between LEC and U.S. industry input price growth rates are unreliable. Measures of LEC productivity growth relative to the U.S. as a whole provide reliable targets for the annual price cap adjustment formula, and attempts to fine-tune such a formula using short-term changes in the input price differential will not lead to greater accuracy or larger welfare gains. Productivity measures must be calculated—as nearly as possible—at the level of aggregation of the entire firm. Because the production processes for interstate and intrastate (or regulated and unregulated) services are not separable, attempts to calculate service-specific productivity growth rates or to adjust total-firm TFP estimates for relative growth rates of particular inputs are futile. Finally, though the historical price and TFP methods of appraising past industry performance are based on the same basic economic theory and similar assumptions, (i) the TFP-based calculation is less sensitive to violations of those assumptions, (ii) the historical revenue approach does not have the theoretical support that the TFP and historical price methods possess, and (iii) the historical revenue approach requires many additional unrealistic conditions which do not hold in the telecommunications industry.